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(54) **OPTICAL DEVICE UTILIZED IN LASER PROJECTOR**

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H04N 9/31 (2006.01)

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CPC ***G03B 21/16*** (2013.01); ***G03B 21/204*** (2013.01); ***G03B 21/2033*** (2013.01); ***H04N 9/3144*** (2013.01); ***H04N 9/3158*** (2013.01)

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See application file for complete search history.

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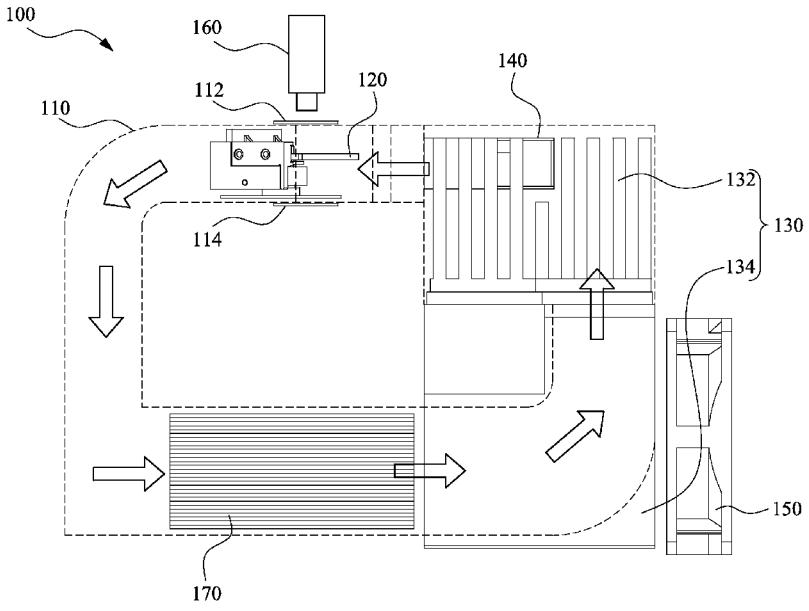
(57) **ABSTRACT**

An optical device utilized in a laser projector includes a circulatory air channel, a phosphor wheel disposed in the circulatory air channel, a thermal exchanger partially disposed in the circulatory air channel, and an air guiding component disposed in the circulatory air channel for guiding an air provided by the thermal exchanger toward the phosphor wheel. The temperature of the air passing through the phosphor wheel is lower than an environment temperature.

9 Claims, 2 Drawing Sheets



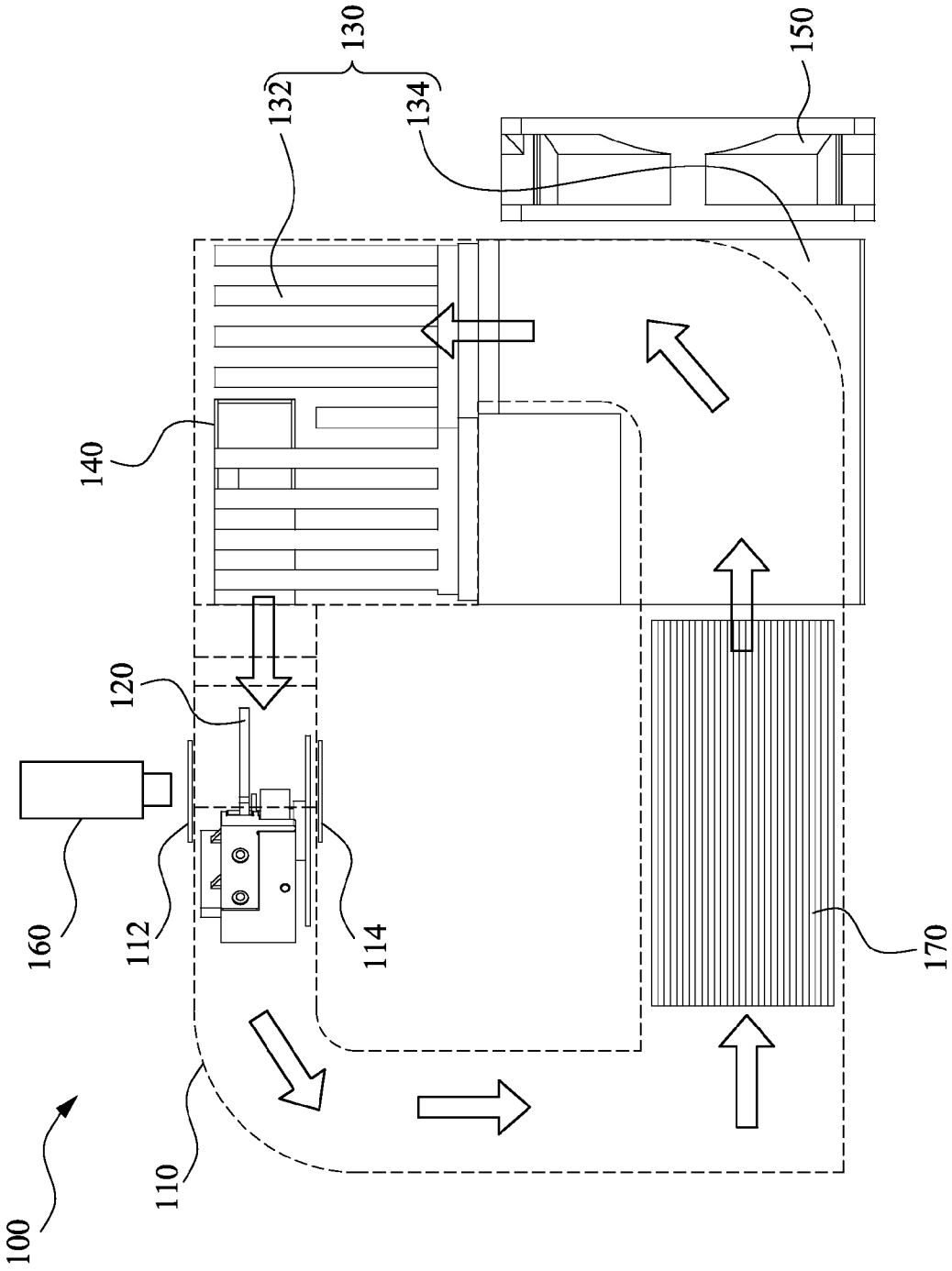


Fig. 1

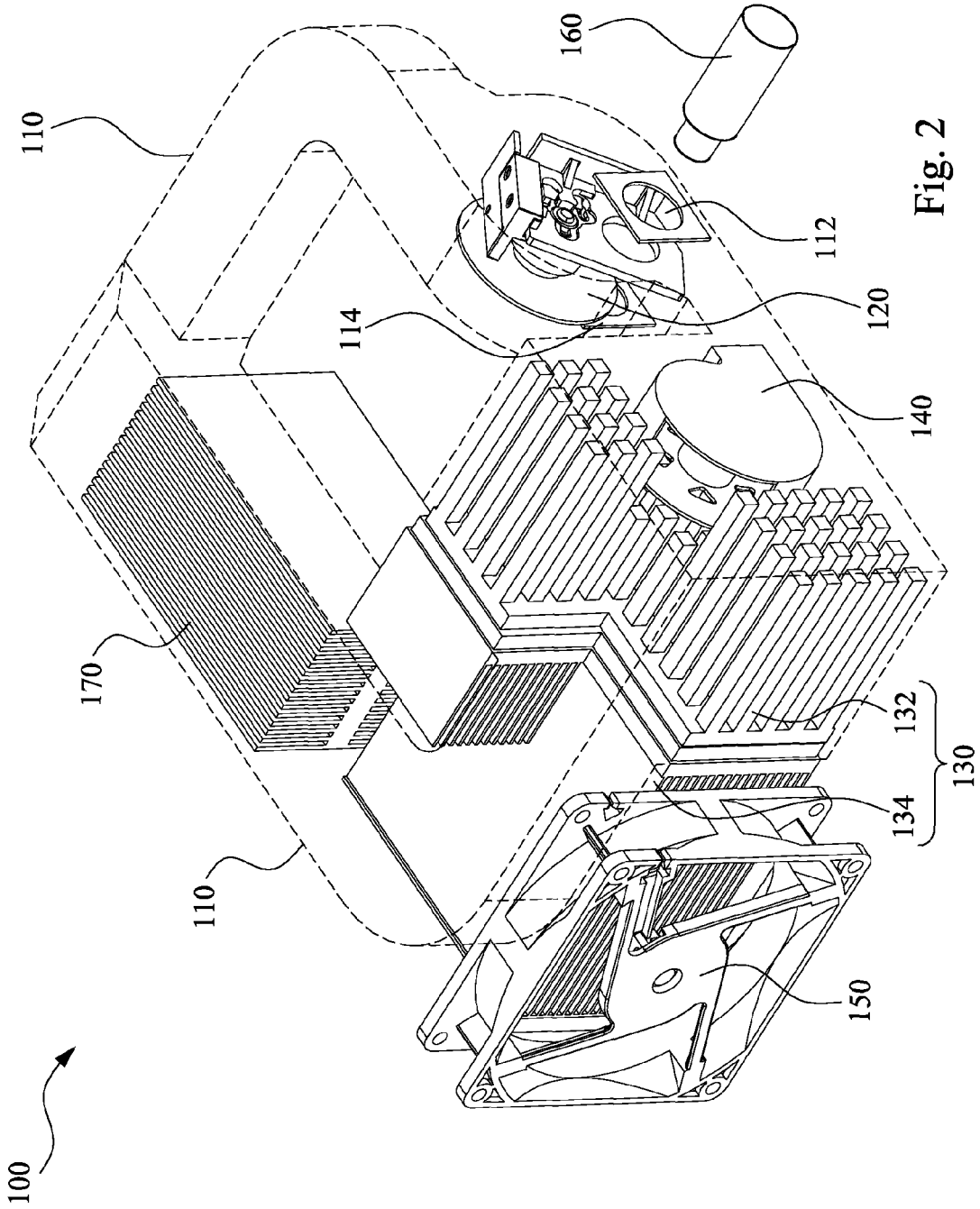


Fig. 2

OPTICAL DEVICE UTILIZED IN LASER PROJECTOR

RELATED APPLICATIONS

This application claims priority to China Application Serial Number 201320443781.2, filed Jul. 24, 2013, which is herein incorporated by reference.

BACKGROUND

1. Field of Invention

The present invention relates to a laser projector. More particularly, the present invention relates to an optical device in the laser projector.

2. Description of Related Art

Optical projectors have been applied in many fields since first being developed. They serve an expanded range of purposes, from use in consumer products to high-tech devices. For example, the optical projectors may be used in projective systems for projecting enlarged images to facilitate presentations given in conferences, or used in projection screens or televisions for projecting and displaying images in real time.

A conventional projector typically includes a light source module and an image processor. The light emitted from the light source module is collected by optical components and is processed by a filter and a color wheel. The processed light is supplied to the image processor and subsequently projected onto a projection screen.

With constant development of the projectors, a laser light source and a phosphor wheel have been utilized in the light source module for providing light beams with various wavelengths. However, the energy carried by the laser light beam is highly intensified, and the temperature of the wheel may be very high after a time of receiving the laser light beam. As a result, the phosphor on the phosphor wheel may be deteriorated which decreases the illuminating efficiency of the phosphor. As brightness requirements for projectors continue to increase, so does the energy carried by laser light beams generated therein. Hence, the problem of phosphor deterioration from the high temperatures is becoming increasingly severe.

SUMMARY

The present invention provides an optical device utilized on a laser projector, which provides an air colder than an environment air for cooling a phosphor wheel, so that the problem of phosphor damaged due to high temperature can be prevented.

An aspect of the invention provides an optical device utilized in a laser projector, which includes a circulatory air channel, a phosphor wheel disposed in the circulatory air channel, a thermal exchanger partially disposed in the circulatory air channel, and an air guiding component disposed in the circulatory air channel for guiding an air provided by the thermal exchanger toward the phosphor wheel. The temperature of the air is lower than an environment temperature.

In one or more embodiments, the thermal exchanger can be a thermoelectric cooling chip, the thermoelectric chip has a cold side and a hot side, the cold side is disposed in the circulatory air channel, and the hot side is partially exposed of the circulatory air channel.

In one or more embodiments, the optical device further includes a cooling fan disposed adjacent to the hot side for dissipating heat from the hot side.

In one or more embodiments, the air guiding component is disposed adjacent to the cold side, and the air guiding component is a blower or a fan.

In one or more embodiments, the air guiding component and the phosphor wheel are disposed at opposite sides of the cold side respectively.

In one or more embodiments, the optical device further includes a laser light source for providing a laser beam emitting to the phosphor wheel.

In one or more embodiments, the circulatory air channel comprises a first light passage and a second light passage disposed corresponding to a light receiving side and a light emitting side of the phosphor wheel respectively.

In one or more embodiments, the first light passage and the second light passage can be plane glasses.

In one or more embodiments, the optical device further includes at least one cooling fins set partially disposed in the circulatory air channel.

In one or more embodiments, a shape of the circulatory air channel can be a rectangle.

The present disclosure uses the air cooled by the thermal exchanger for cooling the phosphor wheel thereby enhancing the cooling efficiency to the phosphor wheel. Furthermore, the air circularly flowing in the circulatory air channel is cleaner than the air outside of the leaser projector, the problem of the dust pollution carried by the outside air can be prevented.

It is to be understood that both the foregoing general description and the following detailed description are by examples, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention. In the drawings,

FIG. **1** is a top view of an embodiment of an optical device utilized in a laser projector of the invention; and

FIG. **2** is an oblique view of the embodiment of the optical device utilized in the laser projector of the invention.

DESCRIPTION OF THE EMBODIMENTS

Reference will now be made in detail to the present embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

In order to solve the problem of phosphor wheel being damaged because of the raising temperature due to the high energy carried by the laser beam, a fan is widely used for cooling the phosphor wheel with environment air. However, the cooling efficiency by using only the fan is pretty poor. Therefore, the present invention provides a thermal exchanger and a circulatory air channel for cooling the phosphor wheel with a cold air colder than the environment air thereby improving the heat dissipating efficiency of the phosphor wheel.

FIG. **1** is a top view of an embodiment of an optical device utilized in a laser projector of the invention. FIG. **2** is an oblique view of the embodiment of the optical device utilized in the laser projector of the invention. The optical device **100** is utilized in a laser projector. The optical device **100** includes

a circulatory air channel **110**, a phosphor wheel **120** disposed in the circulatory air channel **110**, a thermal exchanger **130** partially disposed in the circulatory air channel **110**, and an air guiding component **140** disposed in the circulatory air channel **110**.

In order to better perform the features of the present invention, the circulatory air channel **110** is illustrated with broken line in FIG. **1** and FIG. **2**.

The circulatory air channel **110** provides a channel for allowing an air flowing within circularly, and the air is basically recyclable utilized in the circulatory air channel **110**. The thermal exchanger **130** provides a cold air, which has a temperature lower than the environment temperature, flowing in the circulatory air channel **110**. The environment temperature means a room temperature outside of the laser projector, or the temperature in laser projector but not within the circulatory air channel **110**. The temperature of the cold air provided by the thermal exchanger **130** must be colder than both above environment temperatures.

The air guiding component **140** is disposed in the circulatory air channel **110**. The air guiding component **140** is disposed between the thermal exchanger **130** and the phosphor wheel **120** for guiding the cold air provided by the thermal exchanger **130** to the phosphor wheel **120** for cooling the phosphor wheel **120**. The air guiding component **140** can be a blower or a fan. The temperature of the cold air provided by the thermal exchanger **130** is lower than the temperature of the environment temperature. Such that, comparing to conventional cooling method by only using the environment air, the present invention has higher cooling efficiency by using the cold air provided by the thermal exchanger **130**.

The cold air provided by the thermal exchanger **130** is guided via the air guiding component **140** toward the phosphor wheel **120** for cooling the phosphor wheel **120** by thermal exchanging process. The cold air is heated after being thermal exchanged with the phosphor wheel **120**. The heated air flows in the circulatory air channel **110** along a predetermined air flow direction. The heated air once again passes the thermal exchanger **130** for being cooled and becomes the cold air. The cold air cooled by the thermal exchanger **130** is once again guided to the phosphor wheel **120** for cooling the phosphor wheel **120** via the air guiding component **140**. The air is basically recyclable utilized in the circulatory air channel **110**.

The circulatory air channel **110** can be substantially regarded as a closed chamber, so that the air is utilized repeatedly in the circulatory air channel **110**. The air circularly flowing in the circulatory air channel **110** can be cooled by the thermal exchanger **130** for cooling the phosphor wheel **120**. Furthermore, the air circularly flowing in the circulatory air channel **110** is cleaner than the air outside of the leaser projector, which may include dust, soot or other pollutions. The problem of poor cooling efficiency and the dust pollution carried by only using the fan inducing the outside air raised in prior art can be prevented in the present disclosure.

The thermal exchanger **130** can be a thermoelectric cooling chip. The thermal exchanger **130** includes a cold side **132** and a hot side **134**. The cold side **132** includes a plurality of cold side fins. The hot side **134** includes a plurality of hot side heat dissipating fins. The cold side **132** is located in the circulatory air channel **110**. The cold side **132** and the phosphor **120** are disposed at opposite sides of the air guiding component **140**. The cold air provided by the cold side **132** of the thermal exchanger **130** is guided by the air guising component **140** toward the phosphor wheel **120** for cooling the phosphor wheel **120**. The hot side **134** is partially exposed of the circulatory air channel **110**. The hot side **134** is utilized for heat dissipating by thermal exchanging with the air outside of the circulatory air channel **110**.

The optical device **100** further includes a cooling fan **150** for cooling the hot side **134** of the thermal exchanger **130**. The cooling fan **150** is disposed outside of the circulatory air channel **110**. The cooling fan **150** is disposed adjacent to the hot side **134** for dissipating heat from the hot side **134** thereby improving heat dissipating efficiency of the hot side **134**.

The optical device **100** further includes a laser light source **160**. The laser light source **160** provides a laser beam emitting to the phosphor wheel **120**. In order to make the laser beam entering and exiting the circulatory air channel **110**, the circulatory air channel **110** further includes a first light passage **112** and a second light passage **114**. The first light passage **112** and the second light passage **114** are disposed corresponding to a light receiving side and a light emitting side of the phosphor wheel **120** respectively. The first light passage **112** is disposed between the laser light source **160** and the phosphor wheel **120**. The first light passage **112** and the second light passage **114** are made of transparent material, such as a glass, so that the laser beam may pass through the circulatory air channel **110**, and the air may be kept in within the circulatory air channel **110**. The first light passage **112** and the second light passage **114** can be plane glasses.

The laser beam with a first wavelength passes the first light passage **112** and emits onto the phosphor wheel **120**. The laser beam with the first wavelength is converted by the phosphor wheel **120** and becomes a beam with a second wavelength. The beam with the second wavelength emits through the second light passage **114** and enters an image processing unit for imaging. In some embodiments, the second light passage **114** can be plane glass or lens for further adjusting light path.

In order to further improve the cooling efficiency to the phosphor wheel **120**, the optical device **100** may optionally include at least one cooling fins set **170**. A part of the cooling fins set **170** is disposed in the circulatory air channel **110**, and another art of the cooling fins set **170** is exposed of the circulatory air channel **110**. The air passed the phosphor wheel **120** is heated, and the heated air may heat exchange with the cooling fins set **170** thereby dissipating a part of heat carried by the heated air.

Although only one set of cooling fins set **170** and one thermal exchanger **130** are discussed in this embodiment, the number of the cooling fins set **170** and the thermal exchanger **130** is not limited and can be plural in other embodiments. A person having ordinary skill in the art may design the arrangement of the cooling fins set(s) **170** according to actual requirements.

The shape of the circulatory air channel **110** is substantially a rectangle. The cold side **132** of the thermal exchanger **130**, the air guiding component **140** and the phosphor wheel **120** are basically placed at the same side of the circulatory air channel **110** in order to make the air flow smoothly.

The present disclosure uses the air cooled by the thermal exchanger for cooling the phosphor wheel thereby enhancing the cooling efficiency to the phosphor wheel. Furthermore, the air circularly flowing in the circulatory air channel is cleaner than the air outside of the leaser projector, the problem of the dust pollution carried by the outside air can be prevented.

Although the present invention has described in considerable detail with reference to certain embodiments thereof, other embodiments are possible. Therefore, the spirit and scope of the appended claims should not be limited to the description of the embodiments contained herein.

It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.

What is claimed is:

1. An optical device utilized in a laser projector comprising:

a circulatory air channel;

a phosphor wheel disposed in the circulatory air channel;

a thermal exchanger partially disposed in the circulatory air channel; and

an air guiding component disposed in the circulatory air channel for guiding an air provided by the thermal exchanger toward the phosphor wheel,

wherein

a temperature of the air passing through the phosphor wheel is lower than an environment temperature,

the thermal exchanger is a thermoelectric cooling chip,

the thermoelectric chip has a cold side and a hot side,

the cold side is disposed in the circulatory air channel, and

the hot side is partially exposed in the circulatory air channel.

2. The optical device utilized in the laser projector of claim **1**, further comprising a cooling fan disposed adjacent to the hot side for dissipating heat from the hot side.

3. The optical device utilized in the laser projector of claim **1**, wherein the air guiding component is disposed adjacent to the cold side, and the air guiding component is a blower or a fan.

4. The optical device utilized in the laser projector of claim **3**, wherein the air guiding component and the phosphor wheel are disposed at opposite sides of the cold side respectively.

5. The optical device utilized in the laser projector of claim **1**, further comprising a laser light source for providing a laser beam emitting to the phosphor wheel.

6. The optical device utilized in the laser projector of claim **5**, wherein the circulatory air channel comprises a first light passage and a second light passage disposed corresponding to a light receiving side and a light emitting side of the phosphor wheel respectively.

7. The optical device utilized in the laser projector of claim **6**, wherein the first light passage and the second light passage are plane glasses.

8. The optical device utilized in the laser projector of claim **1**, further comprising at least one cooling fins set partially disposed in the circulatory air channel.

9. The optical device utilized in the laser projector of claim **1**, wherein the circulatory air channel is rectangle-shaped in cross section.

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